WE CLAIM:

1. A method for analog representation of the amplitudes of a vector,

wherein single-stranded oligomers E_i and $\underline{E}_i$ are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors $\boldsymbol{e}_i$, $i = 1,2,\ldots,m$ in an abstract m-dimensional vector space;

wherein a set of the oligomers E_i and $\underline{E}_i$ represents an m-component vector $\boldsymbol{V} = \sum_i V_i \boldsymbol{e}_i$, wherein the E_i and $\underline{E}_i$ oligomers have complementary nucleotide sequences, with the E_i oligomers representing the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive, and the $\underline{E}_i$ oligomers representing the i-th component of $\boldsymbol{V}$ for which V_i is negative; and

wherein the concentration of each of the oligomers E_i or $\underline{E}_i$ is proportional to the magnitude of the amplitude V_i of the i-th component of $\boldsymbol{V}$.

2. The method of claim 1, wherein the oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides; and any single oligomer comprises one or a combination of two or more of said different types of subunits.

3. A method for analog representation of the operations of vector and matrix algebra,

wherein each vector is represented by a set of the oligomers E_i and $\underline{E}_i$ according to claim 1, and

wherein the operations of vector addition and vector and matrix algebra are represented by biochemical processes and reactions involving said oligomers E_i and $\underline{E}_i$, comprising diffusion, molecular recognition, specific hybridization of complementary oligomers, and sequence-specific reactions of nucleic acid-modifying enzymes acting on the oligomers.

4. The method of claim 3, wherein the oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides; and any single oligomer comprises one or a combination of two or more of said different types of subunits.

5. A method for implementing an analog neural network, wherein data of each neuronal unit, in the form of m-component vectors $\boldsymbol{V} = \sum_i V_i\, \boldsymbol{e}_i$, are each represented by a set of the oligomers E_i and $\underline{E}_i$ that are a subset of all single-stranded oligomers and are each in 1:1 correspondence with the basis vectors $\boldsymbol{e}_i$, i = 1,2,..., m, in an abstract m-dimensional

vector space;

wherein a set of the oligomers E_i and $\underline{E}_i$ represents an m-component vector $\boldsymbol{V} = \Sigma_i V_i \boldsymbol{e}_i$, wherein the E_i and $\underline{E}_i$ oligomers have complementary nucleotide sequences, with the E_i oligomers representing the i-th component of $\boldsymbol{V}$ for which the amplitude V_i is positive, and the $\underline{E}_i$ oligomers representing the i-th component of $\boldsymbol{V}$ for which V_i is negative; and

wherein the concentration of each of the oligomers E_i or $\underline{E}_i$ is proportional to the magnitude of the amplitude V_i of the i-th component of $\boldsymbol{V}$;

wherein the interconnections and signaling between neuronal elements are represented by a set of biochemical reactions involving the oligomers E_i or $\underline{E}_i$ that are analog representations of operations of vector addition and vector and matrix algebra; and

wherein application of a saturating function to a signal from one or more neuronal units to produce an output is represented by hybridization of a set of oligomers selected by said set of biochemical reactions to a complete, sub-stoichiometric set of single-stranded E_i and $\underline{E}_i$ oligomers, and an output of the neural network is represented by a set of oligomers that specifically hybridize to said sub-stoichiometric set of E_i and $\underline{E}_i$ oligomers.

6. The method of claim 5, wherein the oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides; and any single oligomer comprises one or a combination of two or more of said different types of subunits.

7. The method of claim 5, wherein a content addressable memory is represented by a pool of oligomers having selected sequences, and a subset of the oligomer strands representing a particular experience V_i^b is used to obtain the set of oligomer strands representing the complete experience V_i^b, comprising the steps of:

(a) obtaining single-stranded oligomers representing a set of vectors V_i^a, each of which vectors represents an item of experience,

(b) storing the items of experience in memory by forming the outer product over all the experience vectors V_i^a for $i \neq j$:

$$T_{ij} = \sum_a V_i^a V_j^a,$$

(c) retrieving a particular experience V_i^b that is imperfectly represented as U_i^b, in accord with

$$V_i = \mathbf{S}(\sum T_{ij} V_j + U_i^b),$$

where the function $\mathbf{S}(x)$ is a saturating function, by finding a set of oligomer strands X_i corresponding to the inner product

of the strands representing the T_{ij} matrix and the strands representing vector U_i^b,

(d) hybridizing the oligomer strands representing X_i to a hybridization array comprising a complete set of anchored E_i and $\underline{E}_i$ strands, washing the hybridization array to remove excess X_i strands, and identifying the depot sites of the array that contain double-stranded oligomer complexes,

(e) denaturing the duplex molecules in the hybridization array and collecting the set of oligomer strands $\mathbf{S}(X_i)$ representing the saturated X_i strands,

(f) repeating steps (c), (d), and (e) iteratively, using the X_i oligomer strands obtained in each previous iteration to obtain a new set of strands X_i' representing saturated X_i selected from the inner product of the strands representing the T_{ij} matrix and the strands representing X_i, until two successive iterations yield the same set of oligomer strands representing the complete experience V_i^b.

8. The method of claim 7, wherein the oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides; and any single oligomer comprises one or a combination of two or more of said different types of subunits.

add C1

add D1

ADD H1

ADD J1